

Claims

1. A doubly doped lithium niobate crystal, wherein iron and a second radius-matched ion both are doped in the mean time into LiNbO_3 , its composition being denoted as $\text{Li}_{1-x}\text{Nb}_{1+y}\text{O}_3\text{:Fe}_m\text{M}_n$, where M is magnesium, indium, or zinc, when using q to denote the ion valence of M ($q=2$ when M is Mg or Zn, and $q=3$ when M is In), the values of x, y, m, and n are in the range of $0.05 \leq x \leq 0.13$, $0.00 \leq y \leq 0.01$, $5.0 \times 10^{-5} \leq m \leq 7.5 \times 10^{-4}$, and $0.02 \leq qn \leq 0.13$.

2. The doubly doped lithium niobate crystal as claimed in Claim 1, wherein said composition can doped with 0.007~0.03 wt.% Fe and 1.0~5.0 mol.% Mg, while the congruent composition is $[\text{Li}]/[\text{Nb}]=0.90\sim0.95$.

3. The doubly doped lithium niobate crystal as claimed in Claim 1, wherein said composition can doped with 0.01~0.05 wt.% Fe and 0.75~3.0 mol.% In, while the congruent composition is $[\text{Li}]/[\text{Nb}]=0.91\sim0.95$.

4. The doubly doped lithium niobate crystal as claimed in Claim 1, wherein said composition can doped with 0.02~0.06 wt.% Fe and 1.5~6.5 mol.% Zn, while the congruent composition is $[\text{Li}]/[\text{Nb}]=0.87\sim0.95$.

5. A process for growing doubly doped lithium niobate crystal as claimed in anyone of Claim 1 -4, wherein said process includes the following steps:

(1) Weigh up high purity Li_2CO_3 , Nb_2O_5 , Fe_2O_3 , and MgO , In_2O_3 or ZnO powders according to the crystal composition, and dry them at $120\sim150^\circ\text{C}$, then thoroughly mix them lasting for 24 hours, and keep them at $800\sim850^\circ\text{C}$ for 2~5 hours to make Li_2CO_3 decompose sufficiently, and then sinter at $1050\sim1150^\circ\text{C}$ for 2~8 hours to obtain doubly doped lithium niobate powder.

(2) Put the above doped lithium niobate powder into a Pt crucible after impacted, then heat the powder by a middle frequency stove; Grow the doubly doped lithium niobate crystals using the Czochralski pulling method along c or a axis via the procedures of necking, shouldering, uniform-diametering, and tailing,

with the pulling rate being 1~3 mm/h, the rotation rate being 15~30 rpm, the temperature difference of the melt-crystal interface being 20°C, the temperature gradient in the melt volume near the surface being 1.5°C/mm, and the temperature gradient above the melt surface being 1.0°C/mm, respectively.

(3) Pole and anneal the grown doped lithium niobate crystals at 1200°C to obtain single-domain doubly doped lithium niobate crystals

6. A usage of said doubly doped lithium niobate crystals claimed in Claim 1, wherein said doubly doped lithium niobate crystals can be used for a three-dimensional optical storage material.